MECHANICS.

NOTE.—Prize Problem No. 86, is open for solution as only one solution has been received, and that one is faulty.

93. Proposed by WALTER H. DRANE, Graduate Student, Harvard University, Cambridge, Mass.

A small rope, which is passed over a smooth pully, has attached at one end a weight of twenty pounds, and at the other end hangs a monkey, also weighing twenty pounds. Is it possible for the monkey to climb to the pulley, and if so, what will happen to the weight?

Solution by the PROPOSER.

When a body is in motion, its weight is altered, becoming greater when the body moves upward, and less when the body moves downward, and this increase or decrease in weight is proportional to the velocity. By this principle, when the monkey starts upward with a velocity, $ds/dt=\frac{1}{20}.Ft$, where F is the force with which he raises himself, his weight is increased by an amount proportional to $\frac{1}{20}Ft$. This force reacts undiminished upon the weight (as the pulley is smooth) and as the mass of the weight is also 20 pounds it must also begin to ascend with the same velocity as the monkey. This in turn increases the weight of the weight until it equals that of the monkey, which counteracts the effect of the monkey's increase in weight, and hence we have the result that monkey and weight will ascend with equal velocities.

94. Proposed by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa.

In a parallelogram $ABCD$, $\angle D=\beta$, $AB=a$, $BC=b$, the principal moments of inertia at the centroid are $(\frac{1}{24}m)[a^2+b^2\pm\sqrt{(a^4-b^4+2a^2b^2\cos2\beta)}]$ and the principal axes at the same point make with the side CD an angle θ given by

$$\tan2\theta=\frac{b^2\sin2\beta}{a^2+b^2\cos2\beta}.$$

Solution by the PROPOSER.

Let $ABCD$ be the parallelogram, O the intersection of the diagonals AC, BD, and OX, OY be the axes. For integration we will transform to OX, OY'..

$$\tan2\theta=\frac{2\Sigma mxy}{\Sigma mx^2-\Sigma my^2}.$$

Σmx^2=moment of inertia about OX

$$=\rho\sin\beta\int_{-\frac{1}{2}a}^{\frac{1}{2}a}\int_{-\frac{1}{2}b}^{\frac{1}{2}b}(x+y\cos\beta)^2dxdy=\tfrac{1}{12}\rho ab\sin\beta(a^2+b^2\cos^2\beta)=\tfrac{1}{12}m(a^2+b^2\cos^2\beta).$$

$$\Sigma my^2=\rho\sin^3\beta\int_{-\frac{1}{2}a}^{\frac{1}{2}a}\int_{-\frac{1}{2}b}^{\frac{1}{2}b}y^2dxdy=\tfrac{1}{12}mb^2\sin^2\beta.$$